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Research Article

Performance of Soil Blocks Using Various Material Combination

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Abstract— **The experimental phase of this investigation consists of different blocks of various material constituents subjected to the loading condition to investigate the behavior of the blocks. Here a cement of (8%, 10% &12%) are added to both red soil & laterite soil and control mix of both soils are also made & are tested and also different trial combinations are also tested in the same way. The remaining combinations made for the replacement of cement. Another set of combinations in which the above stated three combinations of cement are replaced by the substitutes such as 60% fly ash, 25% lime and 15% gypsum. In the same manner red soil with cement are also tested in such a way with different percentage composition. Finally, a total of fourteen mixes are made. From the last study, it is found that compressive strength of the blocks increases with age at curing. The compressive strength of the block samples was determined in accordance with 14th & 28th days and is compared to block containing various combinations. Similarly various tests are done for all the mixes. The test values thus obtained are compared and thus the blocks with higher strength values are noted here. The test methods used are mentioned, and the strength of the test samples is compared with the performance of the blocks. Thus the normal cement concrete blocks & normal burnt clay bricks used now a day can be replaced.**

Keywords- **Concrete blocks, burnt clay bricks**

I. INTRODUCTION

The use of concrete blocks for buildings and high-rise buildings has become popular due to development in concrete technology and availability of various types of building materials. Concrete blocks could lead to smaller member sizes for compression members and therefore provide considerable savings associated with material costs and reduction of dead loads.

Quantity of materials were collected and transported to the destination. Then blocks of soil samples were prepared by proper batching, weighing, mixing, placing of the mix (mould filling) and the proper compaction of the sample. Optimum moisture content for mix was found out and specimens were prepared. Then the specimens cured in laboratory in open air for 7, 14 & 28 days. Different laboratory tests were conducted.

For the mix proportioning of soil, first control mix for both red & laterite soil were made. As per the studies conducted earlier, trial mixes were made & a result percentage of cement combination to be added were found to be 8%, 10%& 12%.These three percentages were added on soils and another three mixes of cement replacement were made and replaced. That is for each percentage of cement was replaced by 60% fly ash, 20% lime & 5% gypsum .Thus the combination adopted was similar to that of Fal- G bricks.

Here First control mix for both red & laterite soil were made. Wooden mould of size 300x150x100mm was used for block making. In each of these 14 mixes about 8 blocks were made for the various laboratory experiments. And small cubes of size 70x70x70 mm were made for the durability tests such as acid& alkalinity tests .Therefore a total of 28 small cubes; two numbers for each trial mix were made. And about 112 soil blocks were totally made for various tests.

Proportioning of soil-admixture mix

Based on various researches we found that proper grading increases the density of the blocks and improves their compressive strength (Spence, 1975). As a guideline, the best possible combinations such as 8%, 10%, 12% addition of cement and control blocks for comparison in both laterite & red soil were also taken.

II. MATERIALS USED

Cement

Cement can be defined as the bonding material having cohesive & adhesive properties which makes it capable to unite the different construction materials and form the compacted assembly. Here ordinary Portland cement accounts for about 80-90 percentage. Many tests were conducted to cement .Some of them are consistency tests, setting time that is initial &final setting time tests, specific

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gravity test etc. and finally we get the cement grade as 43.

Water:

Fresh and clean water is used for casting and curing the specimens. The water is relatively free from organic matter, silt, oil, sugar, chloride and acidic material as per requirements of Indian standard.

Fine aggregate:

Fine aggregate was clean, sharp, and free from clay and organic matter and well graded in accordance with IS standards. The sand particles should also pack to give minimum void ratio, higher voids content leads to requirement of more mixing water. In the present study the sand conforms to zone II as per the Indian standards.

Laterite soil:

Laterite soil are rich in aluminum and iron, Red in color formed in wet and hot tropical areas. It is prepared by the prolonged and rigorous weathering of the parent rock. One of the main uses of laterites for construction purposes is the production of Compressed Earth Blocks (CEB). The production technology of CEB provides a modern use of lateritic soils which fulfill the requirements for structural performance and quality of buildings.

Red soil:

Red tropical soil (RTS) sample used in this investigation is having a silica to sesquioxide ratio of the soil was 7.2. The soil sample was air-dried, ground and wet sieved obtaining the fineness of 75% passing 45 mm sieve.

Lime:

Lime (CAO), Calcium oxide powder of good quality used in this study. About 20 kg of lime was used for the block making as a substitute of cement. Here the corresponding percentage of cement was replaced by 20% of lime.

***Fly Ash*:**

Fly ash is a waste material from the factories, used for the manufacture of cement. Here class F fly ash is used for the block making. Here, the corresponding percentage composition of cement was replaced by 60% of fly ash.

Gypsum:

Gypsum is a soft sulphate mineral composed of calcium sulphate dehydrate, with the chemical formula $CaSO_4 \cdot 2H_2O$. Here gypsum was used 5% as a replacement of cement. i. e for (8%,10%&12%).

Manufacture of Laterite and Red Earth Stabilized Blocks

Here the laterite & red earth stabilized blocks were made by block moulding, mixing, compacting etc. These blocks use the same parent material as soil but offer the significant advantage of wet compressive strength. One of the methods of stabilization is to compact a soil sample to reduce the voids in the finished block. Various steps to be followed during the production are listed as below:

A. Preparation of Soil:

The soil samples were air–dried for seven days in a cool, dry place. After drying, grinding was carried out using hammer to break the lumps present in the soil. Sieving was then done to remove over size materials from the samples using a 4.75mm sieve. Fine materials passing through the sieve were collected for use, while those retained were discarded.

This method consists of the following operations:

- drying;
- screening;
- Pulverizing.

B. Preparation Of Mix in Block Production.

The blocks prepared on process comprised of batching, mixing, placing the mix, compaction and ejection of the blocks. The required quantities (mass basis) of the ingredients namely, soil, and the stabilizers (lime, gypsum, fly ash and cement) as obtained from the calculations depending on the series were weighed and initially mixed in a dry condition. For making soil blocks, the proportioned dry mix was spread on big tray, and the calculated quantity of water was sprinkled to the mix and thoroughly worked with hand to have uniform distribution of moisture (Plate1). Wet mixing was undertaken for further 2–3 min after the addition of water.

III. PREPARATION OF MIXES

A. Mixing And Moulding

For Laterite samples, first the laterite and cement were properly mixed manually before the addition of water. Here, 7 different mixes for laterite & 7 mixes for the red soil with additives were prepared. To ensure even distribution of blows, approximately 100mm square sheet of plywood was placed on the mixture in the mould. Then the mould was filled with two additional layers of laterite-cement and properly compacted. Similar procedure of mould filling was done for all the 14 mixes. Finally, a total of 126 blocks were prepared in such that the blocks cannot stick on the sides of the wooden mould which causes tearing during extrusion. In order to

avoid that before filling the mould, proper oiling should be made and also ensured that the moulds were filled in three equal layers.

B. Block Manufacturing

Here, in this study, The mould can be made with all the four edges closed with top & bottom in an open manner. The wooden mould is initially oiled overnight and need not be oiled each time it is filled. It is sufficient to wipe it clean with a cloth. The soil mix of stiff or plastic consistency, is placed in the mould in 3 layers and each layer is compacted.

Figure 1: Healing Bricks with different Combinations

Figure 2-a **Figure 2-b**

Figure 2-a : Compression testing machine
Figure 2-b : Compression testing of brick

C. Curing and Crushing

The cubes when extruded were cured in the laboratory under atmospheric condition with all the doors and windows opened to allow proper circulation of air for 7, 14, 21 and 28 days, respectively before crushing. Two blocks from each of the fourteen mixes were crushed in a particular day and the average compressive strength was calculated.

LABORATORY TEST DONE FOR SOIL BLOCKS

- Compressive strength test
- Water absorption test
- Shrinkage test
- Density test

DURABILITY TEST

- Acid test
- Alkali test

IV. RESULTS

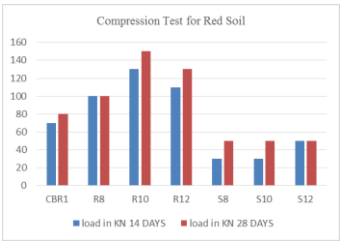

Figure 3 : Compression Test for Red Soil(Load)

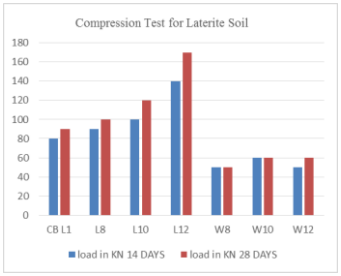

Figure 4:Compression Test For Laterite Soil(Load)

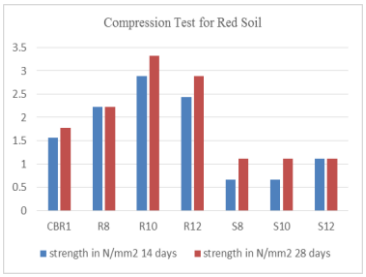

Figure 5: Compression Test for Red Soil (Strength)

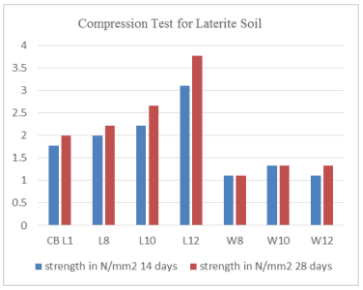

Figure 6: Compression Test for Laterite Soil (Strength)

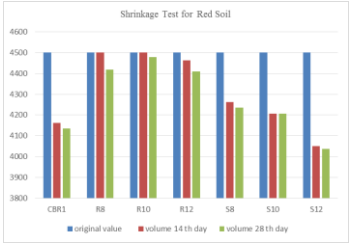

Figure 7: Shrinkage Test for Red Soil (Change in volume)

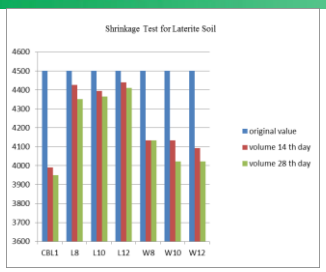

Figure 8: Shrinkage Test for Laterite Soil (Change in volume)

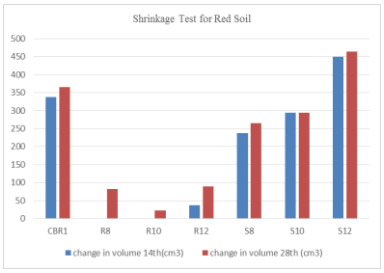

Figure 9: Shrinkage Test for Red soil (Change in volume)

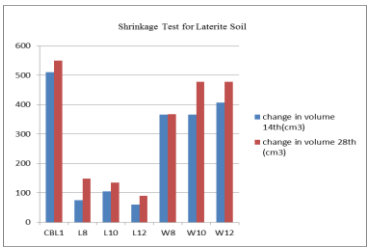

Figure 10: Shrinkage Test for Laterite Soil (Change in volume)

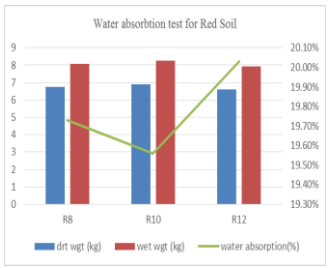

Figure 11: Water absorbtion for Red Soil (In percantages)

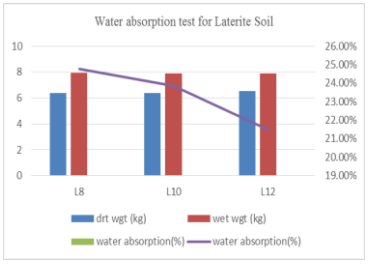

Figure 12: Water absorbtion for Laterite Soil (In percentages)

V. CONCLUSION

The Experimental study of the results from the experiments carried out concludes that shrinkage, strength, water absorption and compressive load carrying capacity are high for laterite soil test subjects in comparison to red soil test samples. The result shows an average difference of 6.8-10.2% in every property of laterite soil samples over red soil samples. Most of the samples show that a curing period change could make adequate changes in the properties.

Further studies could lead to a better building material that could give good strength and having a less investment.

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